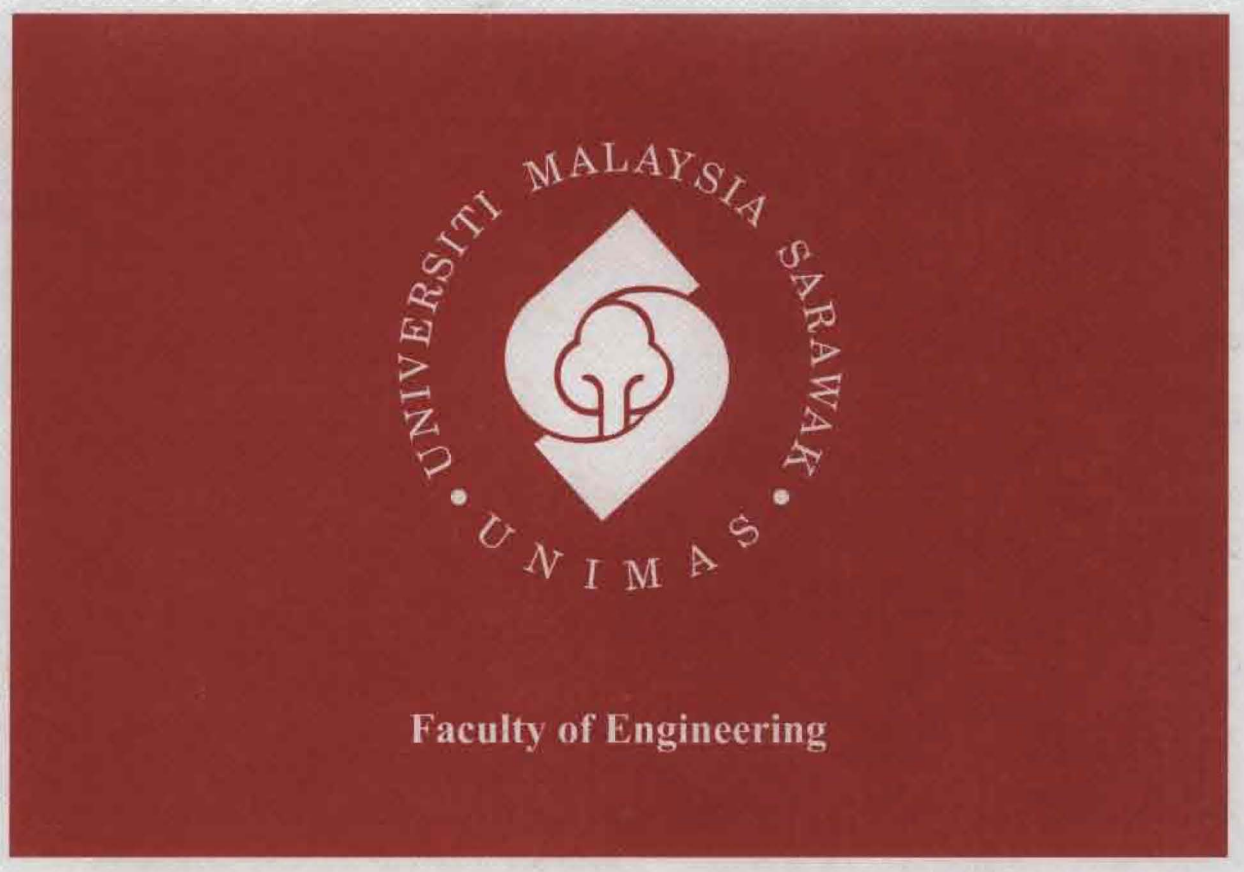

POST-FLOOD FORENSIC ANALYSIS ON SMALL URBAN CATCHMENT USING ONE DIMENSIONAL SYSTEM MODELING

Ting Sie Chun

Master of Engineering
2011

POST-FLOOD FORENSIC ANALYSIS ON SMALL URBAN CATCHMENT USING ONE DIMENSIONAL SYSTEM MODELING

TING SIE CHUN

A thesis submitted
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"I declare that I have read through this project report and to my opinion this project report is sufficient in term of scope and quality for the purpose of awarding the degree of Master of Water Resources Engineering"

Signature: .....

Name of Supervisor: **Professor Dr. Frederik Josep Putuhena**

Signature: .....

Name of Co-supervisor: **Professor Dr. Salim Said**

Title: Post-Flood Forensic Analysis on Small Urban Catchment Using One Dimensional System Modeling

Date: 26th May 2011

I declare that this project report entitled "**Post-Flood Forensic Analysis on Small Urban Catchment Using One Dimensional System Modeling**" is the result of my own work except as cited in the references. The report has not been accepted for any degree and is not currently submitted in candidature of any other degree.

Signature: .....

Name of Candidate: Ting Sie Chun

Date: 26th May 2011

To my beloved family

And all of my friends in Unimas

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ABSTRACT

A 0.47 km^2 of residential houses in Sungai Merah (SM) in the Sibu Town of Sarawak State is located within the Seduan River basin, which is a flood-prone area with relatively flat and typically low-lying floodplain. Poor maintenance, severe conditions and water logging in the current drainage system have causes flooding with addition to water-logged soil-peat. The Wallingford Software model-InfoWorks Collection System (CS), coupled with its embedded Geographic Information System (GIS) applications, is one approach that used to identify the causes of inundation, and to improve performance of the 16 km-drainage system. Results show that flooding in SM area is triggered by tidal influences from the Seduan River. Some part of the drainage system in SM area failed to manoeuvre the flood water using the current existing drainage facilities. Flood mitigation in SM area is part of the Sibu Town urban water management system, which a proposed 3.7 m LSD high levee will be constructed along the Seduan River to protect the residential area from tidal impact. Tidal gates are also provided to overcome the internal drainage problems. The hydrodynamic modeling has shown its capability in identifying the effectiveness of the levee in Sungai Merah area. From this research, it is found that the levee constructed is satisfactory to prevent deluge in SM area for 20 years ARI. The simulated model is useful for the integrated assessment of flood conditions in SM area, for cost-benefit assessment and risk-based design of flood protection measures and hence, it is as a decision support tool for flood risk management.

ABSTRAK

Kawasan perumahan dengan keluasan 0.47 km^2 di Sungai Merah (SM), Bandar Sibu, Sarawak terletak di dalam lembangan Sungai Seduan merupakan kawasan yang kerap banjir dengan dataran banjir yang lazimnya rendah dan mendatar. Sistem perparitan semasa yang tiada penyelenggaraan, keadaan penyaliraan parit yang parah serta tergenang air telah mengakibatkan banjir. Tanah yang carak seperti tanah gambut memburukkan lagi keadaan banjir di SM. Sistem Perisian Wallingford-InfoWorks Collection System (CS), digandingkan dengan aplikasi Geographic Information System (GIS) adalah satu pendekatan untuk mengenalpasti punca-punca berlakunya banjir dan mengenalpasti cara-cara meningkatkan prestasi sistem perparitan sepanjang 16 km. Keputusan simulasi menunjukkan banjir di SM dipengarahi oleh pasang surut dari Sungai Seduan. Sesetengah bahagian dalam sistem perparitan sedia ada di kawasan SM gagal untuk mengawal keadaan air banjir. Tebatan banjir dalam kawasan SM ialah salah satu bahagian sistem pengurusan air di Bandar Sibu yang mana pembinaan tetambak setinggi 3.7 m LSD sepanjang Sungai Seduan dicadangkan untuk melindungi kawasan perumahan dari kesan pasang surut. Pintu air pasang surut juga disediakan untuk mengatasi masalah saliran perparitan dalaman. Model hidrodinamik memperagakan bukti keupayaannya dalam mengenalpasti keberkesanan tetambak di kawasan SM. Dari penyelidikan ini, didapati tetambak yang dibina telah berjaya menghalang banjir di kawasan SM untuk 20 tahun ARI. Model simulasi berkenaan berguna untuk penilaian bersepadu keadaan banjir di kawasan SM untuk langkah-langkah perlindungan banjir dari segi penilaian kos dan reka bentuk berasaskan

risiko bagi langkah-langkah perlindungan banjir dan sekaligus bertindak sebagai alat sokongan untuk pengurusan risiko banjir.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Introduction

Water is a crucial element to all of us. Human health and socio-economic welfares are dependent on the adequate supplies of suitable quality water. Conversely, excessiveness of water will result in socio-economic damages and loss of lives due to floods. Climate changes, urbanization, increasing utilization of flood plains and reduction in the natural retention capacity of catchment play a vital role in contribution to flood.

In this study, flood prevention and mitigation involve both hydrology and hydraulics study on the urban drainage system. Drainage system depends on the amount of runoff expected during a high intensity rainfall in a short period of time, tidal influences and the elevation of the area being drained. The resulting stormwater which cannot be drained quickly and coincided with the King Tide, leads to water

accumulation and flooding in streets, roads and residential areas. As a result, drainage system in Sibu is the most important infrastructure to protect homes, businesses, roads and agricultural lands from frequent periods of "excess" water whether from rain or tidal. Many Sibu's soils, too, are poorly drained in which its soil type is mainly soft peat. Additionally, Sibu is on a low-lying deltaic area that distress most of the town and suburb areas with water whenever there is rain or tidal.

Understanding the link between drainage systems and our environment is important for a full understanding of this issue. With the rapid development of Sibu Town, effect on land use has paralyzed the drainage system. Direct runoff from storm water towards the drain has increased the volume and velocity of the water flow that overflows into the town and causes flood.

Apart from that, siltation is also a major crisis that contributes to ineffective drainage system in Sibu. Sedimentation of soil in the river mouth of Seduan River (Figure 1.1) has constricted water flow from upstream. As time flies, the erosion process, sedimentation and changing shape of the riverbank have changed the depth of the river in the area. When King Tide struck, the tidal water will back-filled the drainage system of the residential houses along the riverbank that causes inundation to the areas.

Figure 1.1: Existing of sandbar (circled on right photo) at the mouth of Seduan River (see arrow). A Google photo taken in 2001 (left) and photo taken in 2008 (right).

Briefly, improvement on floodplain management should be implemented in the Sibu Town to remove excess water from poorly drained areas and provide trafficable condition for flood mitigation purposes. The Federal Government had injected RM 300 million for the flood mitigation project for phase I and might extend beyond the 10th and 11th Malaysia Plans which cost more than RM1 billion when completed (Eastern Times, 2010).